

Proper motion sky survey of 2.7 million stars with the Bordeaux automatic meridian circle

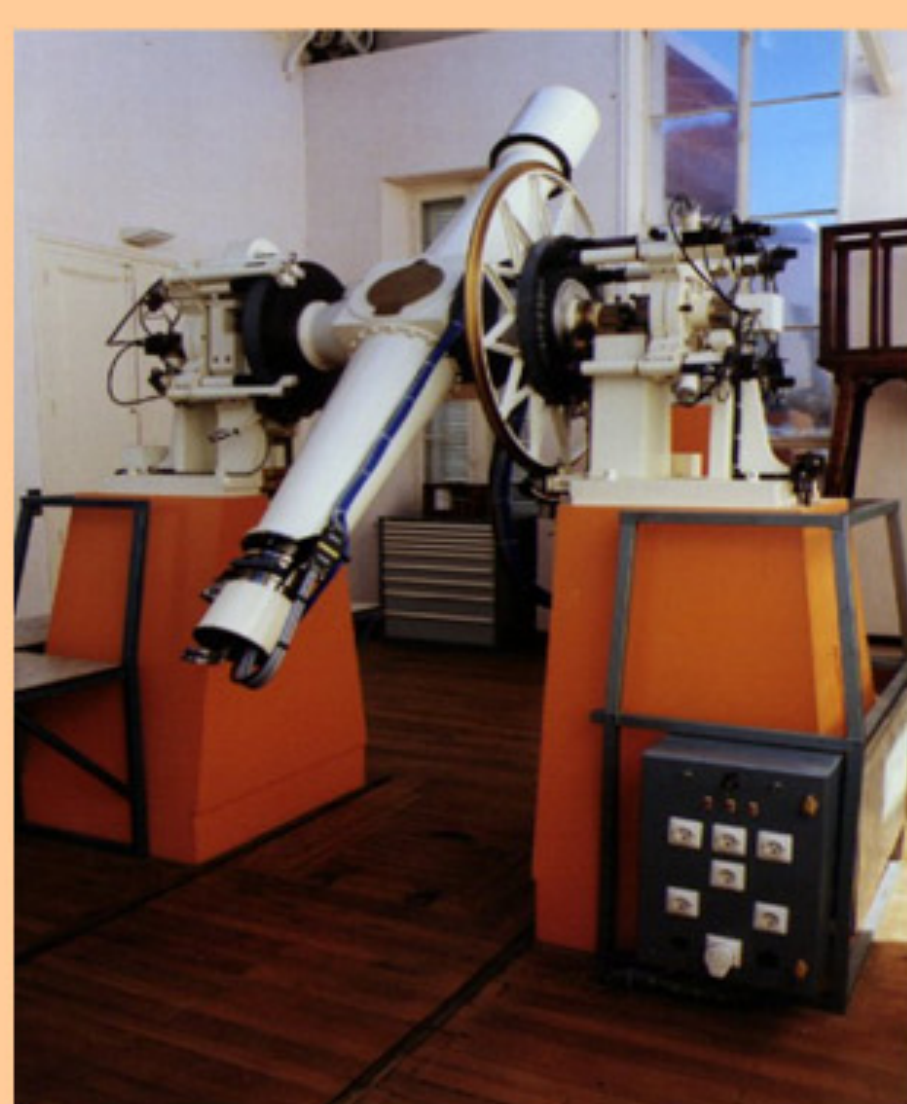
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Abstract:

The Bordeaux observatory astrometric group has performed significant efforts to produce and exploit large data base surveys. This effort has been realized to extend and densify the ICRS materialized by Tycho2 catalogue. It concerns the systematic re-observation of the Bordeaux Carte du Ciel zone with the Bordeaux automatic CCD meridian circle; it also concerns the digitization of ancient plate archive and the exploitation of large sky surveys such as the AC2000.2 catalogue, the USNO-A2.0 catalogue and the unpublished Yellow Sky (YS3) USNO catalogue. The whole effort led to the construction of three astrometric catalogues (M2000 [Rapaport et al. 2001], PM2000 [Ducourant et al. 2005] and CdC2000 [Rapaport et al. 2005]) of positions and proper motions ($\sigma \sim 1-6$ mas/yr) down to $V \sim 16.4$ for 1/20 of the celestial sphere. The high precision achieved, allowed us to test the precision of the present day reference catalogues such as 2MASS and UCAC2 and to reveal systematic offsets in them. It also allowed us to improve Tycho2 astrometry at epoch ~ 1900 . Due to its accurate proper motions, this catalogue constitutes a rich database for the cinematic analysis of Galactic stellar populations.

1 - M2000 : A positional CCD meridian catalogue

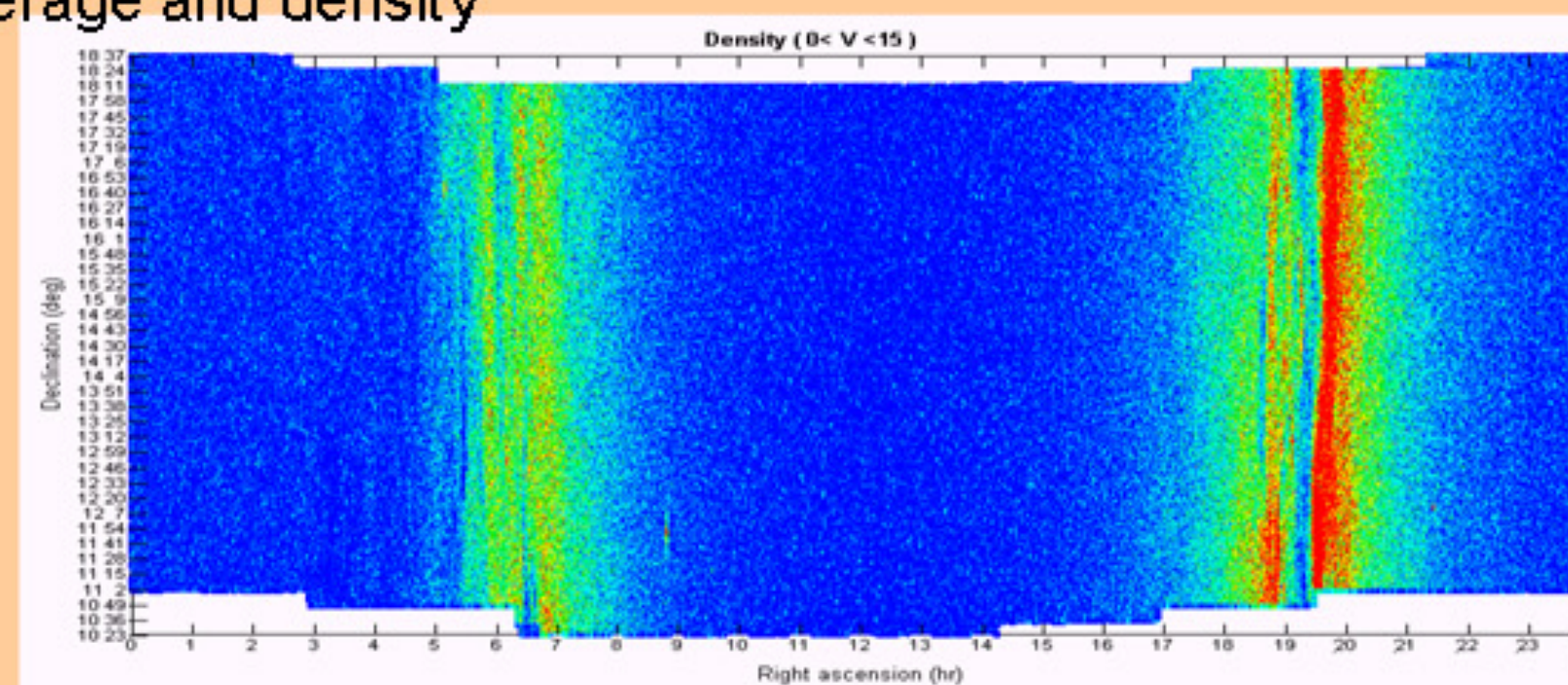


✓ The aim of this work has been to observe with our automated CCD meridian circle the Bordeaux Carte du Ciel zone ($11 \text{ deg} < \delta < 18 \text{ deg}$).

✓ First observations began in December 1996 and the program was completed in December 2000 after 3306 hours of observations in a fully automatic mode. The objective to get at least 6 observations per star for more than 95% of the catalogue was successfully achieved. The observed strips of the whole zone were reduced together with a global procedure described in Rapaport et al 2001.

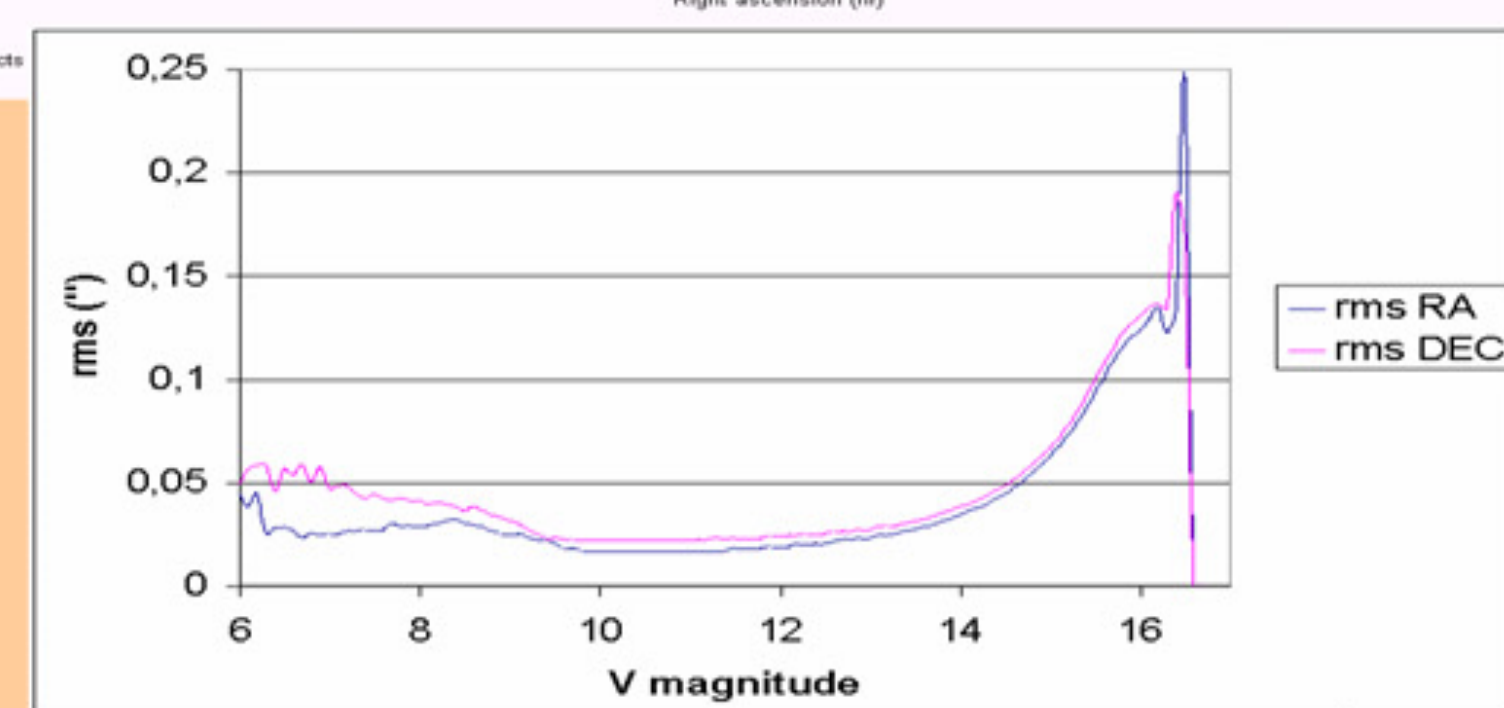
M2000 : astrometry for 1/20 of the sky

• Sky coverage and density



• Comparison to Hipparcos and bright Tycho2 stars : $\sigma_{\alpha, \delta} = 40 \text{ mas}$

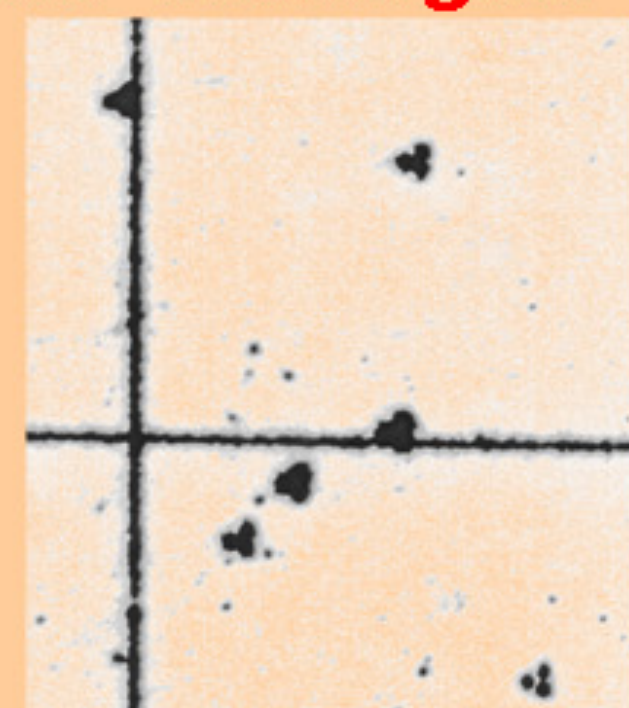
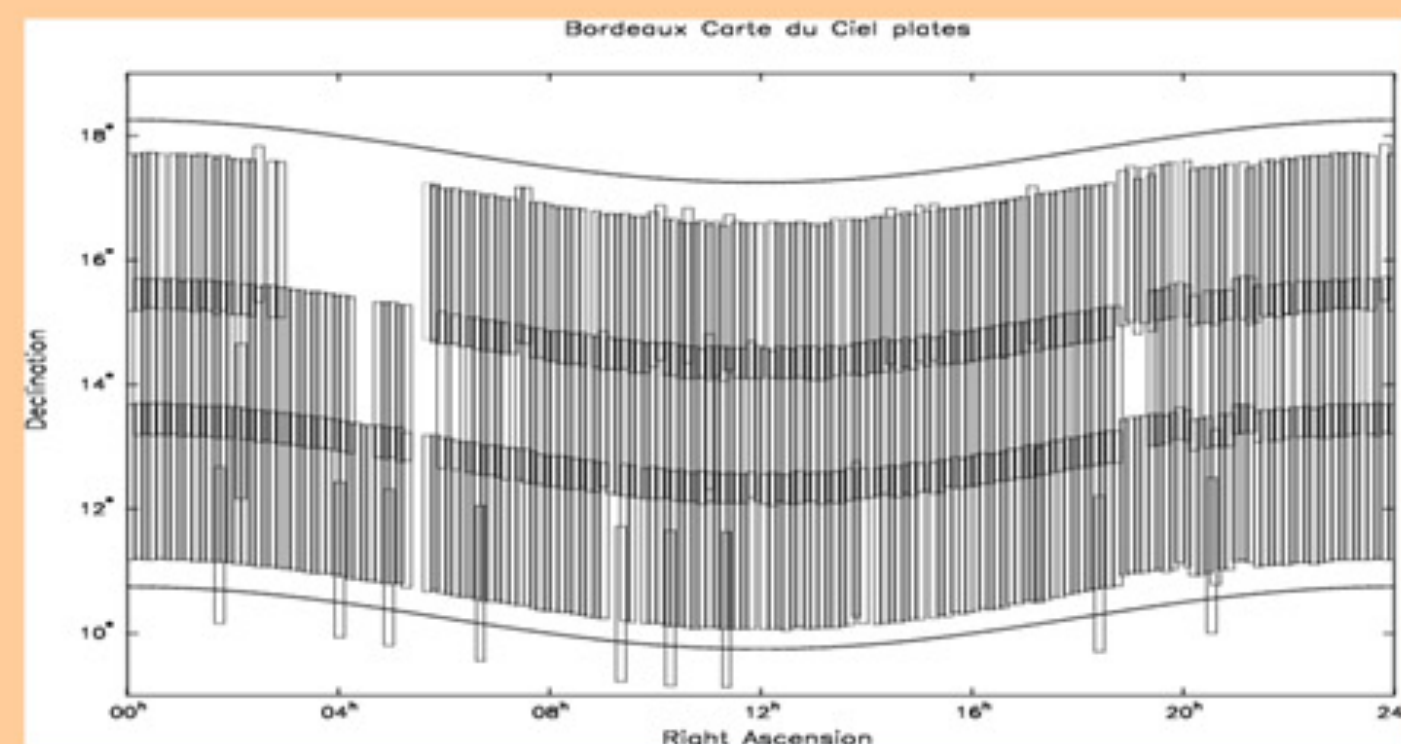
• Precision



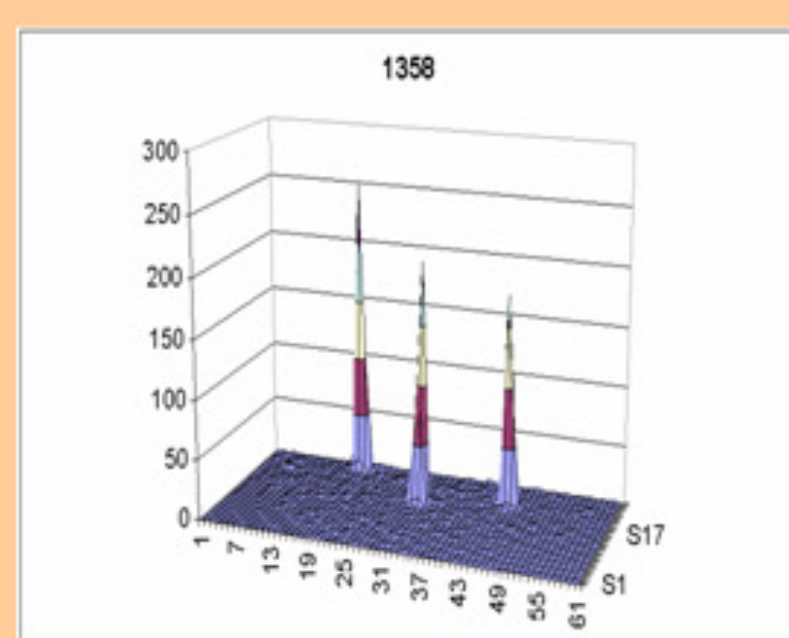
• Comparison to faint Tycho2 : underestimation of errors by Tycho2 (82 mas instead of 116 mas)

Rapaport et al. 2001 A&A, 376, 325

2 - CdC2000 : A positional Carte du Ciel catalogue



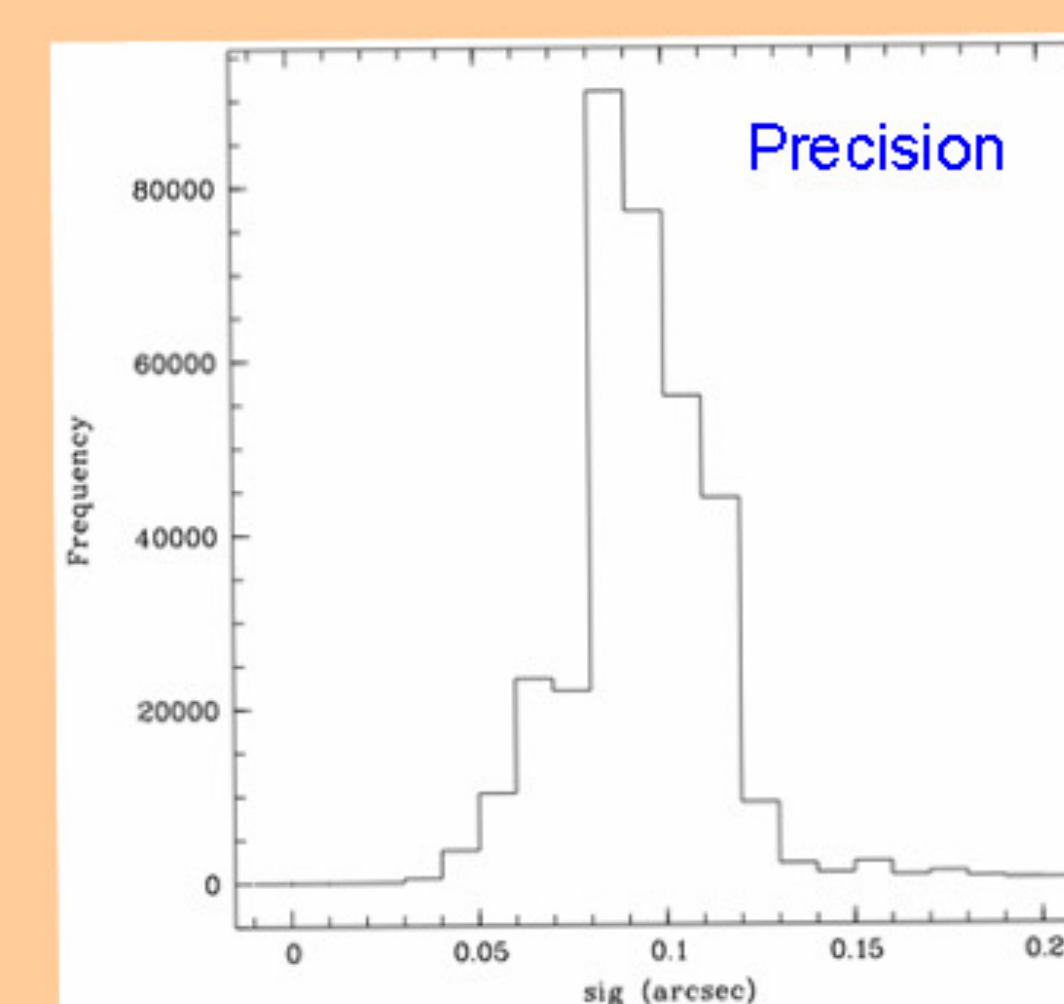
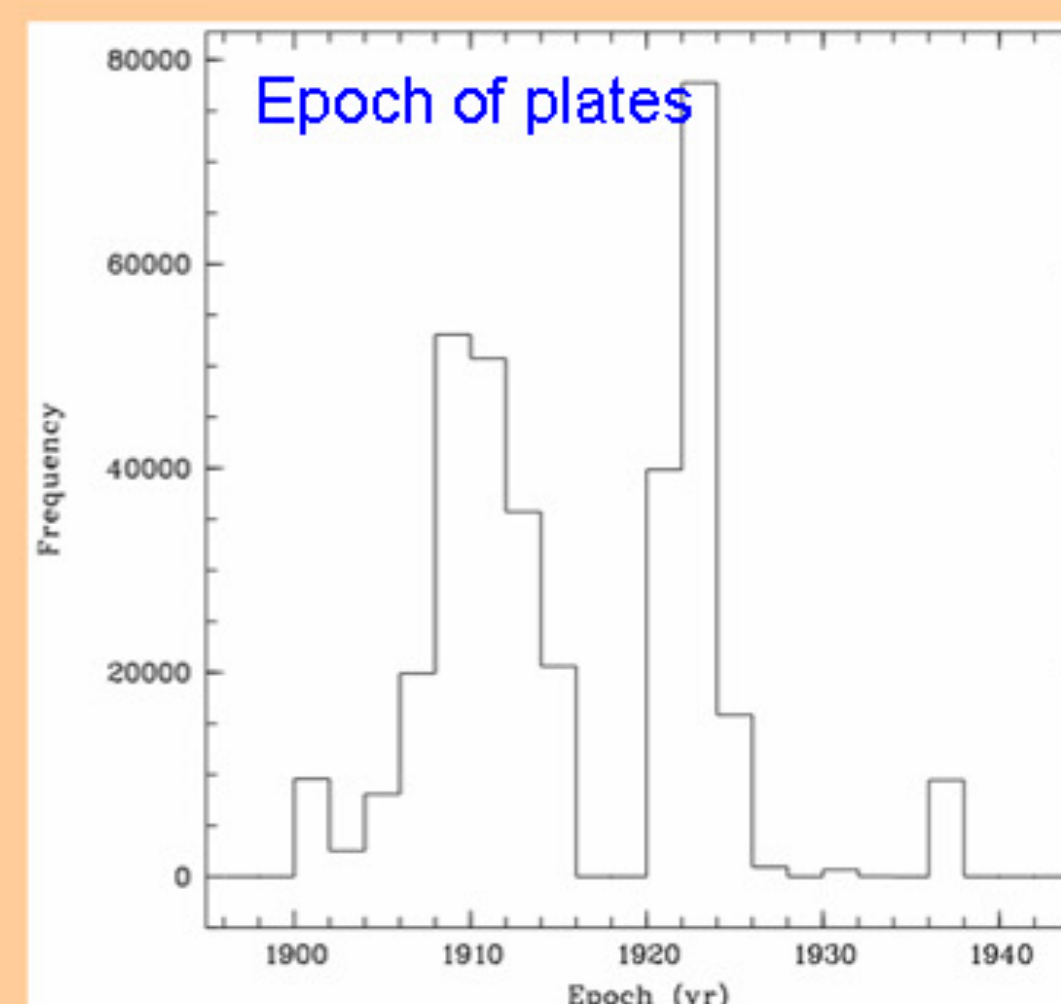
Triplet recognition



- CdC2000 is a positional catalogue of 344 781 stars at mean epoch ~ 1914.7
- Data are from the 512 Bordeaux Carte du Ciel plates
- Plates were reduced using Tycho2 catalogues

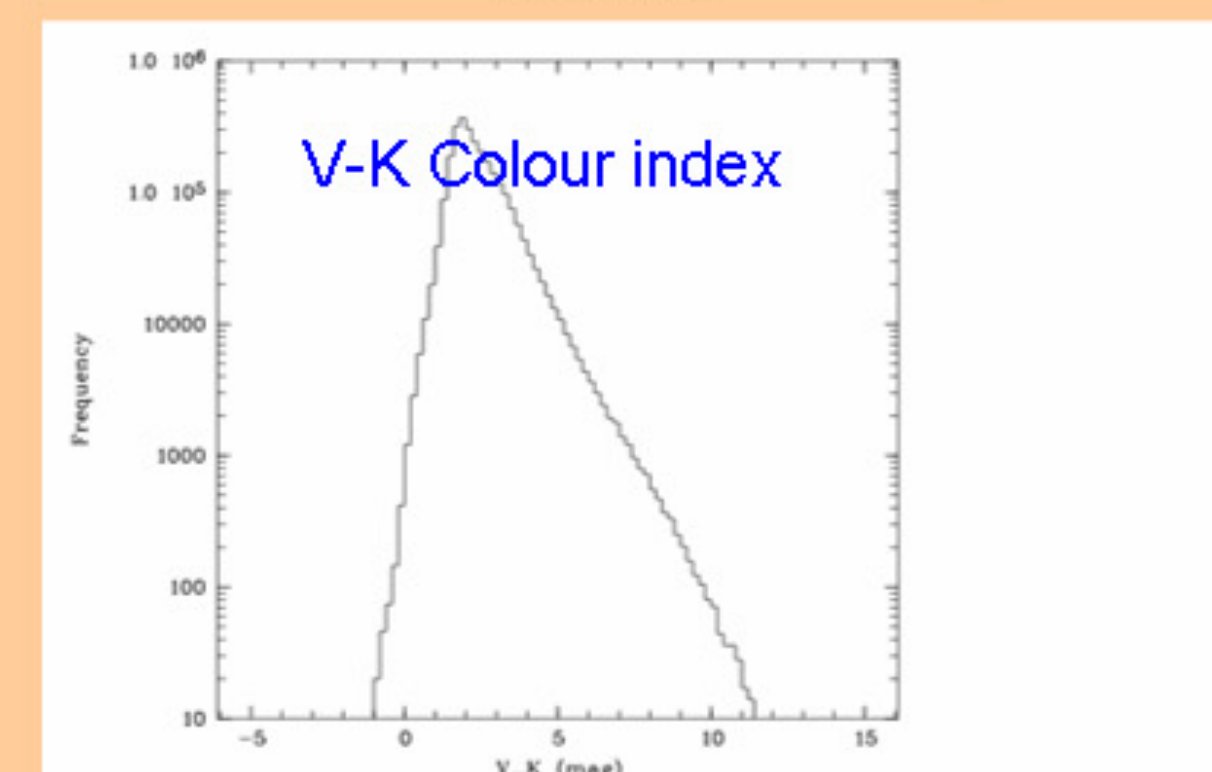
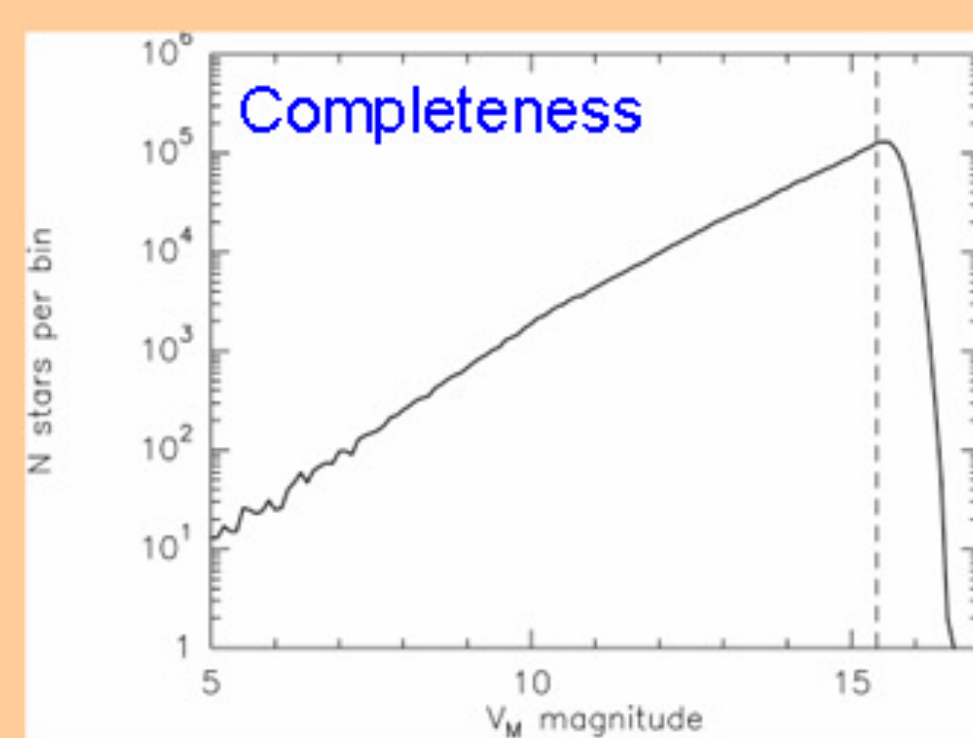
• $\sigma_{\alpha, \delta} = 0.10'' - 0.12''$

CdC2000 : Positions at mean epoch 1900



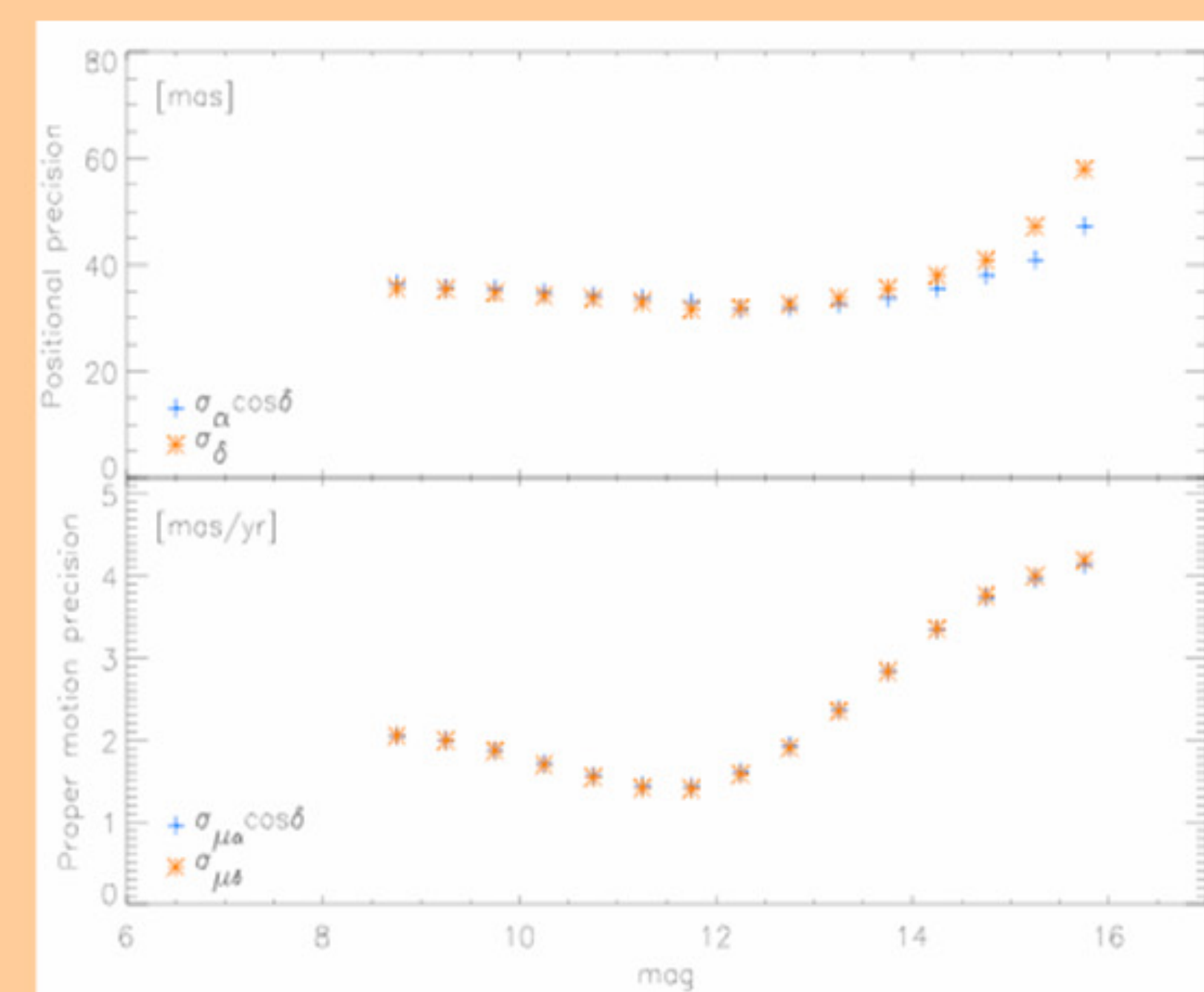
- Comparison to HIPPARCOS and bright TYCHO2 external $\sigma_{\alpha, \delta} = 40 \text{ mas}$
- Comparison to faint TYCHO2 underestimation of errors by TYCHO2 (82 mas instead of 116 mas)

3 - PM2000 : A proper motion catalogue in 1/20 of the sky



- Proper motions were derived from the comparison of the positional M2000 catalogue with positions derived from the reduction of 512 Carte du Ciel plates of the Bordeaux zone (scanned at the APM Cambridge), the AC2000.2 catalogue, the USNO-A2.0 catalogue and the unpublished Yellow Sky (YS3) USNO catalogue.
- The catalogue has a limiting magnitude $V=16.2$ and is complete down to $V=15.4$.
- Positional precision at mean epoch is : $\sigma_{\alpha, \delta} = 50 - 70 \text{ mas}$
- Precision of proper motions varies is : $\sigma_{\mu_{\alpha, \delta}} = 1.5 \text{ mas/yr to } 6 \text{ mas/yr}$
- Systematic offsets in 2MASS positions and in UCAC2 proper motions were revealed from comparisons with PM2000.

Distribution of model-based standard errors



Summary: Due to its accurate proper motions and its limiting magnitude, the PM2000 catalogue is an important database for the study of the kinematics of Galactic populations; The declination zone covered by the catalogue crosses twice the Galactic plane and reach close to North Galactic Pole allowing to study various Galactic regions; it is also an interesting database for the search for nearby stars based on their high proper motions and Galactic associations based on the stellar density and common proper motions.